

Appendix E
PLACER LEGACY DRAFT STRATEGY FOR THE CONSERVATION OF
BIOLOGICAL RESOURCES

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INTRODUCTION

In 1994 Placer County updated and adopted its General Plan, which contains numerous goals, policies, and programs that encourage the conservation of open space and the protection of agricultural resources. In 1998 the County formed a partnership with the Sierra Business Council to initiate the preparation of an implementation program to accomplish these goals. The result was the Placer Legacy Open Space and Agricultural Conservation Program.

Placer Legacy is guided by an eleven member Citizens Advisory Committee that provides recommendations to the Board of Supervisors. An Interagency Working Group, consisting of representatives from state and federal agencies and local governments with jurisdiction in Placer County, will ensure that Placer Legacy is in compliance with all laws, regulations, policies, and ordinances. An independent Scientific Working Group will ensure that the conservation actions recommended by the County and its consultants are scientifically sound.

The Placer County Planning Department, working with Thomas Reid Associates and other consultants, is now developing open space and agricultural conservation strategies in coordination with the Citizens Advisory Committee and appropriate local, state, and federal agencies. Open space issues include agricultural conservation, public safety, cultural resources, community edges and urban separators, outdoor recreation, and biological resources. This draft conservation strategy specifically addresses biological resources.

CONSERVATION STRATEGY

The biological resources conservation strategy of the Placer Legacy project intends to conserve biodiversity county-wide. It will do this by implementing the open-space and habitat conservation policies and programs contained in the 1994 General Plan and numerous community plans. Conservation areas and easements will be acquired only from willing sellers. It is anticipated that the costs of implementing the plan will be covered both by public funding and development impact

fees. General goals are (1) to conserve representative natural habitats within the Great Valley, Foothill, and Sierra Nevada ecoregions, (2) to identify and conserve smaller sensitive communities at the scales at which they occur, (3) to maintain or restore key ecosystem processes, and (4) whenever, possible, to reduce threats to biodiversity (e.g., unnecessary habitat conversion, fragmentation, or degradation; disruption of ecosystem processes; invasive exotic species).

REGULATORY COMPLIANCE

Much land in Placer County is privately held, and a substantial portion of the currently undeveloped private land is already entitled for development. If state or federally listed species are involved, developers will have to secure incidental take permits from the U.S. Fish and Wildlife Service, the National Marine Fisheries Service, or California Fish and Game. The cost of a permit is mitigation through a Section 7 consultation or a Habitat Conservation Plan (HCP) under federal law or a more comprehensive Natural Communities Conservation Plan (NCCP) under state law, plus the time it takes to negotiate these. If each developer has to negotiate his/her own HCP, mitigation tends to be done piecemeal and is dependent upon the landowner to provide the appropriate conservation measures. However, if Placer County develops an HCP or NCCP, mitigation can be coordinated, conservation standards and objectives can be set higher, and a much more effective reserve design will result plus the burden on the each individual landowner can be reduced. Furthermore, an HCP or NCCP will guarantee that lands set aside for conservation will be protected over the long term as specified in the applicable plan and not subject to the whims of politics.

Conservation actions under Placer Legacy will be far more efficient under an HCP or NCCP because of its county-wide scope and long planning horizon. Placer County has developed a comprehensive database for conservation planning that is appropriate in scale and detail. In addition, the County will be in a much better position to acquire conservation lands outright, purchase conservation easements, undertake restoration projects, and develop incentives for sustainable use that correspond to local community values than would any individual effort.

Placer Legacy will develop a countywide HCP/ NCCP in three distinct planning phases which are tied to habitat types. Planning phases have been prioritized by the immediacy of the threat to species in these habitat types. Table 1 shows the proposed schedule for phasing.

Table 1. Major planning phases and conservation targets for regulatory compliance in Placer County.

Phase 1

Western County

vernal pool/grassland
valley riparian
salmonid habitat in streams

Phase 2

Foothills

foothill oak woodland

East Side Sierra Nevada
Martis Valley/Tahoe

Phase 3

West Side Sierra Nevada
public and private timberlands

East Side Sierra Nevada
public and private timberlands

WESTERN COUNTY AND FOOTHILLS

Valley Grassland/Vernal Pools

Prior to European settlement, the valley grassland habitat was most likely a perennial bunchgrass prairie. The introduction of domestic livestock and the seeds of alien annual grasses, large-scale cultivation, and changes in the fire regime have resulted in the replacement of the original prairie with annual grassland. Valley grassland now consists mostly of introduced annuals, although native bunchgrasses and forbs occur sparsely throughout and some remnant stands of native prairie still may occur. The valley grassland community occurs as a ring around the Central Valley from sea level to about 3900 feet and also forms the understory for oak woodlands.

Valley grasslands in Placer County are habitat for numerous sensitive animal species including Swainson's hawk and the burrowing owl, and they support the majority of the county's vernal pools. Vernal pools are seasonal wetlands that form in shallow depressions of various sizes at sites where soils contain an impermeable layer that produces a perched water table. The depressions fill during winter rains and dry out completely by spring or summer.

There are two types of vernal pools in Placer County. *Northern volcanic mudflow vernal pools* occur on Tertiary volcanic mudflows called lahars. These small pools form in irregular depressions in gently sloping surfaces on the Merhten Formation. A second type, *northern hardpan vernal pools* occur on acidic soils on old alluvial fans ringing the Central Valley. Pools tend to be clustered in archipelagos in localities where the proper conditions for their formation occur.

California vernal pool vegetation is characterized by high endemism, and more than 70% of the plant species are native annuals. Introduced species comprise less than 7% of this flora; unlike the surrounding grassland, vernal pools have resisted invasions well. The number of species within an individual pool (alpha diversity) is usually low and is related to pool area, pool depth, and the amount of bare ground. However, the number of species among pools in an archipelago (beta diversity) is quite high. Thus, typical vernal pool plants are characterized by highly subdivided populations with low genetically effective sizes and low dispersability.

A few vertebrates such as salamanders and spadefoot toads use vernal pools for breeding, but the vast majority of the pool fauna consists of invertebrates. Listed species that are found in vernal pools in Placer County include the vernal pool fairy shrimp and the vernal pool tadpole shrimp and one plant, the Boggs Lake hedge-hyssop.

Valley grassland/vernal pool habitats continue to disappear under agricultural, residential, and industrial development. Most of the few remaining pools have been damaged or disturbed, and they continue to face a variety of threats including inappropriate livestock grazing, off-highway vehicle use, watershed alteration, and trash dumping. Conservation efforts will focus on archipelagos of vernal pools; fencing off a single pool surrounded by development is not an effective strategy because of the low alpha diversity of individual pools. Furthermore, because of the complexity of vernal pool habitats and their associated watersheds, strategies for their conservation must include the surrounding grasslands. In particular, adequate habitat for the pollinators of the vernal pool flora must be included. The areal requirements of these pollinators is currently unknown but is a high-priority for future research (see below).

We estimate that between 3-5,000 acres of high-quality vernal pool/grassland habitat could be available for one or more core conservation areas within the County. These core areas will be obtained from willing sellers through purchases or easements and will be conserved independently of any mitigation for future development. Selection criteria for acquisitions of remnant grasslands include the amount of endemism, extent of disturbance, and type of land use. For grassland/vernal pool complexes additional criteria include hydrology, position in the watershed, pool density, and pool species diversity and composition.

As buildout occurs, vernal pool mitigation, paid for by impact fees, will occur along the perimeter of the core areas. At the present time, the total area necessary for effective vernal pool conservation is not known. However, this is a high-priority research item (see below).

Valley/Foothill Riparian

Riparian areas perform vital ecological services such as dissipating stream energy associated with high water, filtering sediment, capturing bedload, aiding floodplain development, improving ground-water recharge, and providing key fish and wildlife habitat. Many species, including a large number of sensitive species, are dependent on riparian zones during some or all of their life cycles.

Valley foothill riparian (VRI) habitats occur in the Great Valley and Sierra Nevada Foothills subregions from sea level to about 3000 feet. They are generally associated with low velocity flows, flood plains, and gentle topography. In Placer County they are associated with perennial streams such as the Bear River, Dry Creek, Coon Creek, Pleasant Grove Creek and Auburn Ravine. A healthy, mature VRI forest has a canopy layer of cottonwood, California sycamore, valley oak, or some combination of the three.

Research has repeatedly demonstrated causal linkages between riparian condition and fish habitat quality. Particularly important functions of riparian forests are their ability to provide shade and a source of wood to streams and to regulate inputs of nutrients and other materials. It is also well known that maintaining the physical connection between riparian forests along fish-bearing streams and the rest of the stream network is a necessary prerequisite for high quality stream habitat. VRI habitats provide food, water, migration and dispersal corridors, and escape, nesting, and thermal cover for a number of wildlife species. Fifty-five species of mammals and 147 species of birds are known to use VRI habitats in the Central Valley region. This represents 30% of the mammals and 27% of the birds in the entire state.

Periodic disturbance by flooding is necessary to maintain healthy riparian habitats. Thus, management prescriptions for upstream impoundments and diversions will have to be examined and possibly revised. Furthermore, the management of riparian ecosystems has to focus not only on the zone of vegetation immediately adjacent to the stream but also on a broader region that has direct influence on the stream. This broader area has three overlapping zones, (1) a *community influence zone*, the area recognized as clearly riparian, (2) the *energy influence zone* which includes all the riparian area that is likely to contribute energy and structure to the aquatic ecosystem, and (3) the *land use influence zone* in which human activity is likely to influence the aquatic ecosystem by increasing nutrients, sediment, and other factors.

The land use influence zone increases as a function of the type of disturbance, the steepness of surrounding hillsides, and the erodibility of soils. Inappropriate livestock grazing also has a major impact on riparian zones. These relationships are probably multiplicative.

Establishing variable-width riparian management zones (buffer strips) based on stream attributes, the riparian community, and hill-slope gradients, is probably the most effective strategy for conserving riparian zones. This action will result in stabilized stream banks and shoreline and improved water quality, help ensure viability of native species, maintain special habitats and plant and animal community diversity, increase watershed connectivity, maintain floodplains and water tables, and moderate streamflow and sedimentation. Developing scientifically sound guidelines for determining the width of riparian buffer strips is another high-priority research item (see below).

Placer Legacy's conservation plan for valley/foothill riparian communities is to (1) establish and implement over time variable-width riparian management zones and restore riparian connectivity along key creeks using conservation easements from willing sellers, and (2) rehabilitate degraded stream reaches for frog/salmonid habitat in favorable localities by working with the 20 or so federal, state, and local agencies and private groups with ongoing projects and responsibilities in this area.

Salmonid Habitat in Streams

Anadromous salmonids (trout and salmon) have declined because dam construction prevents them from reaching much of their spawning habitat and because the accessible spawning habitats have been degraded from timber harvest, mining, road construction, and other activities that threaten stream and riparian quality. Overfishing and competition with hatchery salmon have played a role in the plight of native salmonids as well.

Although all of the County's major streams supported anadromous salmonids, the Bear River was the only historically significant contributor to the total number of these fish in the Central Valley. Currently, west Placer County streams contribute more to genetic diversity than to total population numbers of any anadromous fish species. Placer Legacy's contribution to anadromous salmonid restoration will be to restore and maintain healthy tributary streams and riparian zones as discussed above.

Oak Woodland

Oak woodland is a 20- to 30-mile wide belt of oak-dominated communities growing between open grassland and montane forest or chaparral. The dominant trees are deciduous oaks, *Quercus*

lobata (valley oak), and *Quercus douglasii* (blue oak) along with *Quercus wislizenii* (interior live oak). At higher elevations, foothill (digger) pine, *Pinus sabiniana*, and black oak, *Quercus kelloggii* become important components in these communities. Ground cover in oak woodlands, except in rare remnant stands, is usually dominated by introduced annual grasses and forbs. Understory shrubs often are few and concentrated on shallower soils.

Oak woodlands are important wildlife habitat, with over 300 vertebrate species relying on them for feeding, cover, or nesting sites. These communities are also very important to water quantity and quality, and they provide public recreation and aesthetics.

Since European settlement, oak woodlands have been managed primarily for livestock and firewood production, and over 80% are in private ownership. Historically, losses of oak woodlands occurred because of clearing for range improvements and agriculture and fuel wood harvest. Old aerial photographs show that many of the existing oak woodlands in small-parcel rural residential areas are second-growth stands that have replaced fruit orchards abandoned about 50 years ago. The major losses of oak woodland now are from intensive residential and industrial development. Poor oak and understory shrub recruitment and regeneration are problems in some areas.

Oak woodlands present a substantial management challenge at the landscape scale; road networks, fragmentation, and increasing interface with urban areas pose major threats to their biodiversity. Road networks increase wildlife mortality and provide invasion opportunities for invasive exotic species; fragmentation results in the isolation of small, extinction-prone populations; and urban encroachment brings household pets, humans, and fuels management policies into these habitats.

If approved by the Board of Supervisors, Placer Legacy will attempt to acquire by purchase or easement a substantial acreage of oak woodlands in the area bisected by Coon Creek and the Bear River. This area has the largest stands of undeveloped and unfragmented oak woodlands in Placer County and is adjacent to similar stands in Nevada County. If successful acquisitions are made, the area will be managed as a regional park/conservation reserve.

Most of the oak woodland in the southern and central parts of the county is zoned for rural residential development. In this area Placer Legacy will undertake a vigorous outreach and education program to educate land owners about the biological values of oak woodlands. This education program will be accompanied by a concerted effort to encourage landowners to adopt voluntary conservation and fire safety guidelines for their properties.

Placer Legacy also will identify properties for easements to enhance north-south and east-west connectivity in the oak woodland zone. Ideally, such properties should be part of large, contiguous, high-quality stands of oak woodlands with connectivity to riparian zones. Both east-west and north-south connectivity in this zone are important to the County's biodiversity. The persistence of many foothill species depends on north-south connectivity, and up-elevation range shifts facilitated by east-west connectivity may allow for the persistence of species that can no longer live at lower elevations because of global warming.

Research is currently underway in areas zoned as rural residential in the oak woodland zone to determine the extent to which native biodiversity is conserved along the development-density gradient (see below).

SIERRA NEVADA

Habitat Types

A series of major habitat belts resulting from changes in elevation and topography runs lengthwise (primarily north-south) along the Sierra Nevada. Most of these belts can be further subdivided into habitat types determined by elevation, exposure, soils, and past disturbance. *Zonal habitat types* develop within certain elevational boundaries on well-drained sites with moderate slope and well-developed soils. *Intrazonal habitat types* occur within or are interspersed with zonal habitats in places that have poor drainage, steep slopes, or unusual soils. *Azonal habitat types*, such as riparian zones and wet meadows, develop wherever the right conditions occur at any elevation. The major habitat belts and habitat types are shown in Table 2.

Table 2. Major Sierra Nevada habitat types.

ZONAL AND INTRAZONAL HABITATS

Foothill woodland/chaparral belt (900'-5,600')

Chamise-redshank chaparral

Mixed chaparral

Westside yellow pine belt (2,600'-7,900')

Ponderosa pine

Sierran mixed-conifer

Montane hardwood-conifer

Closed-cone pine.

Montane hardwood

White fir

Eastside yellow pine belt (5,000'-6,500')

Bitterbrush.

Eastside pine

Jeffrey pine

Lodgepole pine-red fir belt (7,000'-10,000')

Lodgepole pine

Red fir

Aspen

Subalpine belt (9,000'-11,000')

Subalpine conifer

Alpine belt (10,600'-up)

Alpine dwarf-shrub

AZONAL HABITATS

Montane chaparral

Montane riparian

Wet meadow

In many respects, these are the most important habitat types in the County. Most of them are forests, and forests are fundamental to sustainability. Not only do forests provide commercial timber, fuel, many non-wood products, and recreation, but they also provide invaluable environmental services. They protect watersheds and thus regulate the quantity and quality of water flows. They protect soils with their moisture and nutrients. They modulate climate at local and regional levels through regulation of precipitation and albedo, and they help to slow global warming by acting as carbon sinks. These forest habitats also are home to a number of sensitive species including the bald eagle, northern goshawk, California spotted owl, Sierra Nevada red fox, and California wolverine.

Conservation Needs

The conservation of these habitat types is critically important for biodiversity conservation and sustainable development in Placer County, but the checkerboard ownership pattern in the Sierra Nevada makes effective management at the landscape scale a major challenge. Public lands managed by the U.S. Forest Service, the U.S. Bureau of Reclamation, and the U.S. Bureau of Land Management are interspersed with privately-owned lands. Much of the private land is owned by large corporations, but there are also many smaller holdings.

Placer Legacy will provide opportunities for coordinated land management between a variety of public and private partners. Since so little is understood about how to manage entire landscapes to retain their ecological integrity, adaptive management approaches must be adopted by these partnerships.

In 2000, the U.S. Forest Service is expected to amend 11 forest plans affecting nine million acres of public lands in the Sierra Nevada. The Agency's purpose is to address concerns related to the degradation of aquatic, riparian, old growth, and hardwood ecosystems. Placer County will review the several alternatives presented in the Agency's environmental impact statement and support the plan that will best protect and restore ecological processes and contribute to long-term ecological sustainability and human well-being. The County also will urge the Forest Service to exercise decisive leadership to bring about a new era of management for ecological and economic sustainability.

Major Questions

The following questions have been identified as important to ecological sustainability in the Sierra Nevada. However, these have not yet been addressed by the Citizen's Advisory Committee, the Interagency Work Group, or the Scientific Working Group in any detail. They will be addressed in Phase 3.

Watershed restoration. What are the most effective and cost-effective ways to restore degraded watersheds? Suggested actions include the restoration of natural ecological processes, the rehabilitation of wet meadows, the reduction of road densities, the

establishment and maintenance of variable-width riparian buffers, and the strengthening of mitigation measures related to dams and other water developments.

Wildlife habitat. What is the most effective way to support a diversity of wildlife and other species? Maintaining a variety of successional stages, including late-successional-old growth, is assumed to be very important.

Sensitive areas. Ecologically significant areas and other conservation areas have been identified by the Sierra Nevada Ecosystem Project, the Nature Conservancy, the California Native Plant Society, and other organizations. Should these areas receive special attention from Placer Legacy?

Connectivity. A high level of landscape connectivity is critical to species persistence. Establishing and maintaining habitat connectivity will require land management agencies to coordinate with adjacent public and private landowners. How can this best be accomplished?

Fire management. Can a regional approach to fire management be developed that is biodiversity-friendly, restores the natural role of fire within habitat types and across landscapes, reduces the risk of fire at the urban-wildland interface, and focuses fire suppression efforts in areas where substantial threat to human life and property may exist?

Timber harvest. Does following best forest practices on both public and private lands significantly lessen the impacts of timber harvest? Are these practices especially important on lands adjacent to streams and wet meadows?

Genetic diversity. The genetic diversity of forest resources is critical to sustainability. How can methods for conserving this diversity be developed and implemented on both public and private lands?

Residential development. Many private lands in the Sierra Nevada are planned for or undergoing intensive residential development (e.g., Martis Valley, Squaw Valley, Alpine Meadows, and the Truckee River corridor). How can the impacts of these developments on ecological sustainability be minimized?

Land exchanges and acquisitions. How can land exchanges and acquisitions be most useful in helping consolidate public land into larger and more manageable blocks?

Monitoring. How can a scientifically sound regional monitoring program for tracking ecological and socioeconomic trends and assessing the results of adaptive management actions be developed and implemented effectively?

PRIORITIZED RESEARCH NEEDS

The following research needs have been identified as critical to effective conservation planning (Phases 1-3) and implementation (implementation phase). Although the information from Phase 1 projects will be needed before the information from projects focused on later phases, all of these projects should be funded and contracted as soon as possible.

Riparian Buffer Strips (Phase 1)

Establishing variable-width riparian management zones (buffer strips) is probably the most effective strategy for conserving riparian zones. Thus, developing scientifically sound guidelines for determining the width of riparian buffer strip is a high priority. The product of this research must be a predictive model that uses stream attributes, soil types, topography, and kinds of disturbance to determine the community influence zone, the energy influence zone, and the land use influence zone.

Vernal Pools (Phase 1)

Patterns of alpha and beta diversity in vernal pool complexes in Placer County is essentially unknown, although this information is critical for effective reserve design. Furthermore, little information is available on the habitat requirements of pollinators of vernal pool plants. This information is critical to establish adequate buffers around vernal pool complexes. Research that addresses both of these questions should begin as soon as possible.

Remnant Stands of Native Grassland (Phase 1)

The California Native Plant Society will survey Placer County during the spring of 2000. If this survey locates any remnant stands of native bunchgrass prairie, these stands will be a high conservation priority.

Groundtruthing Geographic Information System Layers (Phases 1-3)

Over the past year the County has obtained an impressive electronic spatial database relevant to biological resource conservation. Coverages include vegetation, soils, land use, wildlife habitat relationships, riparian and vernal pool areas, known locations of sensitive species, and parcel ownership. Some of these coverages will need ground-truthing, however. These coverages need to be identified and the relevant information obtained in the field as soon as possible.

Species Information (Phases 1-3)

Placer County supports several hundred species of vertebrates, over a thousand species of vascular plants, and an indeterminate, but very large, number of invertebrates, nonvascular plants, fungi, and microbes. Planning for all of these species is clearly impossible. Thus, several groups of *target species* must be used as surrogates for species diversity in general. Information must be acquired on the following target groups as soon as possible for HCP/NCCP development and to maintain citizen interest in Placer Legacy.

Species of conservation concern are species that are federally or state listed, proposed for listing, candidates for listing, or have a high likelihood of being listed during Placer Legacy's planning horizon. If these species are likely subject to "take" during future development, and if federal and state standards for issuing take authorizations are met by the biological resources conservation plan, species in this group may receive take authorizations.

"Species profiles" of the 125 or so species that fit into this category are currently in preparation; about three quarters of them have been completed. Information contained in the species profiles includes regulatory status (state and federal), basic life history information, current distribution and abundance statewide and in Placer County, threats to persistence, potential conservation strategy, proposed monitoring program, and literature references and other sources of information. Species profiles will be peer-reviewed by both independent scientists and agency

biologists; after review they will be available to the general public on the "placerbiodiversity.com" web site.

Regional endemics include species that are not listed but are known to have regionally significant populations in the county and are important to include in the planning process to ensure their long-term regional viability (e.g., California slender salamander, *Batrachoseps attenuatus*).

Flagship species are species that are not rare or threatened but are popular with the general public. Although most are well covered by existing regulations, their inclusion in Placer Legacy planning is important to maintain citizen interest. Examples are oaks, mule deer, black bear, mountain lions, and western bluebirds.

The presence of species of conservation concern, regional endemics, and flagship species on conservation lands or lands slated for development will be determined by field surveys as access allows.

Small Patch Ecosystems and Associated Species (Phase 1-3)

The present collection of vegetation coverages is adequate to identify *coarse-scale ecosystems* of matrix-forming vegetation and *large-patch ecosystems*. The former are defined by general, widespread climatic and elevational gradients (e.g., foothill woodland/chaparral belt, westside yellow pine belt), while the latter are relatively discrete communities defined by distinct physical factors and environmental regimes (e.g., chamise-redshank chaparral, closed-cone pine, montane chaparral, valley-foothill riparian).

While these GIS coverages are adequate for much conservation planning, additional work will be necessary to identify *small-patch ecosystems*. These ecosystems, a few square meters to a few thousand hectares in extent, tend to be relatively discrete, geomorphologically defined, and spatially fixed; they often occur because of distinct abiotic factors (geologic outcrops, unique soils, or hydrologic features). Many local-scale invertebrate and plant species are closely connected with specific small-patch ecosystems. These species tend to be poor dispersers or they may be small-patch ecosystem specialists that exist as metapopulations. Examples include plants restricted to unusual soil types, amphibians known from only a few localities, or bats that require caves. Many of these species will require species-specific or site-specific conservation, management, and monitoring.

The first step in locating these small-patch ecosystems and their associated species will be to assemble GIS coverages of topography, geology, vegetation, and soils at a sufficiently fine scale to identify both areas of rapid environmental change and "islands" of unusual soils, rock outcrops, topographic features (e.g., cliffs), or vegetation types and to identify small hydrologic features such as seeps and springs. The second step will be to survey these areas (at least those on public land or on privately-owned land for which access can be obtained) for unique elements of biodiversity. Right now the County does not have the staff or resources necessary for such an undertaking, but it would be an excellent project for one or more graduate students.

There are a number of important outcomes of such a project. First, it will demonstrate that Placer Legacy has examined biodiversity at all relevant scales throughout the entire county. It will help

pinpoint potential locations of unique communities and species, and it can serve as a good demonstration to the public of what already has been lost. This project also will provide baseline data from which to model potential changes in biodiversity under various management scenarios. Moreover, such a study can help make the point that unique biodiversity can be found in many small areas throughout the county and that landowners should be careful stewards of these resources.

Oak Woodlands (Phase 2)

Research has begun to assess the pattern of species persistence along an urbanization and road-impact gradient in the oak woodland zone. The hypothesis to be tested is that species occurrences in this zone are more related to the intensity of land use than to biophysical factors (e.g., soils, exposure, slope). Since the biodiversity of oak woodlands consists of thousands of species of microbes, plants, invertebrates, and vertebrates, two indicator taxa that have proved previously to be useful in this regard (birds and butterflies) have been selected as surrogates for biodiversity as a whole. This research should be completed by the spring of 2001.

Additional coverages will be necessary to establish the spatial arrangement of oak woodland patches and types of connectivity among them. Computer modeling will be necessary to evaluate the range of conservation options available.

Other important research topics include (1) determining the types and densities of key habitat elements necessary to maintain biodiversity in the oak woodland habitat, and (2) identifying the appropriate combination of disturbance, acorn supply, spring precipitation, and predator pressure that leads to successful oak regeneration.

Sierra Nevada River Basins (Phase 3)

The major river basins (e.g., North Fork of the American, Middle Fork of the Rubicon, Bear, Yuba, Truckee) and the lower-order streams that drain into them have been identified as high conservation priorities. However, a detailed GIS analysis of these watersheds will be a prerequisite for informed decision-making, and this has not yet been done.

Monitoring and Adaptive Management (implementation phase)

Placer Legacy will develop adaptive management plans for its conservation lands. Adaptive management is far more than simply trial and error tinkering; rather, it has several key and obligatory steps which include a clear statement of management goals and objectives, conceptual models that explore policy alternatives, targeted research to provide necessary knowledge, selection of appropriate indicators for monitoring, monitoring of indicators, assessment of management effectiveness, and a clear connection between data and further management actions.

Indicators for monitoring will include land cover measured by aerial photographs, population trends in species of conservation concern, presence of habitat indicator species, regional endemics, species associated with unique microenvironments, and invasive exotics such as star thistle. Additional monitoring may be specified in performance standards for a HCP/NCCP.

Habitat indicator species. Many species that are small and difficult to survey will be conserved by conserving healthy habitats, so it is critical to identify more easily surveyed species that are sensitive to the general effects of land use. Taxa that include such species are freshwater mussels,

crayfish, amphibians, fishes, flowering plants, conifers, ferns, tiger beetles, odonates (dragonflies and damselflies), reptiles, butterflies (including skippers), mammals (especially bats), and birds. A suite of habitat indicator species will be selected from these taxa for each of the conservation lands in Placer Legacy. Species selected will be habitat-specific, relatively easy to sample, abundant enough to get reasonable sample sizes, and, whenever possible, chosen from taxa that are popular with the public. Habitat indicator species could include both resident species and species that use habitats in the county for migration or wintering.

Population trends in species of conservation concern. If a species of conservation concern is found to be declining, the first step in reversing that trend is to determine whether it is declining because of a shortage of habitat (area-limited), a shortage of critical resources (resource-limited), an inability to disperse between suitable habitat (dispersal-limited), or is process-limited, (i.e., it would be able to persist if the habitat were managed in a different way). Area-limited species need additional habitat; species unable to disperse across unsuitable habitat require enhanced connectivity. The critical resource(s) identified as limiting for resource-limited species must be increased to a level that meets their needs. For process-limited species it is necessary to identify the processes (population, community, ecosystem) that are limiting and determine how these processes are linked to the persistence of these species, to show explicitly that designated conservation areas will support the appropriate intensity, rate, and frequency of these processes, and to demonstrate, at least qualitatively, how other management actions might affect these processes.

Some species may not be limited by any of the above factors (e.g., it is not clear whether declining amphibians are primarily area-, resource-, dispersal-, or process-limited; many amphibian declines seem to be far too complex to fit neatly into these boxes). Others may be declining because of more straightforward problems such as the invasion of exotics such as star thistle or bullfrogs. In addition, many species themselves control key processes (e.g., gray foxes are key mesopredators and quite sensitive to urbanization). The complexities of managing multi-species reserves should not be underestimated.

County-wide Monitoring (implementation phase)

Placer Legacy also needs to develop a set of indicators that communicates information about changes and trends in the county's environment as a whole in much the same way as employment and inflation rates indicate the health of the economy. This set of environmental indicators will help focus appropriate attention on ecological conditions and help guide informed policy choices. These indicators must be credible, understandable, quantifiable, and broadly applicable. The data that support them must be clear and interpreted objectively.

While some relevant data already are being collected regionally by federal or state agencies, other data need to be obtained by the county. These data include land cover, ecosystem resilience, and ecosystem productivity. Land cover--the types and extent of wetlands, riparian areas, grasslands, vernal pools, etc.--should be surveyed and reported on every five years to determine how conditions are changing. Ecosystem resilience (the capacity of ecosystems to sustain themselves) can be measured by trends in species diversity (as indicated by changes in lists of species of concern), invasive species, nutrient runoff, and soil quality; and a number of indices (e.g., NDVI) can measure ecosystem productivity directly from Landsat data.